E-TAG: Employee Training and Growth through Electronic Games

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Executive Summary

Electronic games have been embraced by individuals across generations and have a long history of use in training for a variety of tasks. We propose an online gaming platform, E-Tag, that:

- Provides tools (games) that evaluate the user's current skill set and comfort level on a variety of skills and attributes.
- Provides features that allow users to understand their own interests and abilities and maps those abilities to specific jobs.
- Supports a virtual network of mentors as resources for career management and planning.
- Supports the development of specific technical skills in the context of solving problems that are directly relevant to the current or future position.
- Provides opportunities for team building within a unit or organization.
- Supports a feedback mechanism to the app development team, so additional games and levels are added as the need for new skills are identified.

E-Tag was conceived as a fun and engaging way to assist adult learners who are interested in advancing their careers. The games and gaming platform are based on current concepts in adult learning theory, such as cognitive learning theory, social reinforcement of learning, experiential learning and active learning. This platform provides a variety of tools for players (employees) to learn in a fun, engaging environment, and is modularized so additional skills and games can be added as needs arise.

Games allow learners to improve their ability in problem solving, teamwork, communication, creativity and innovation, while also learning specific content and technical skills. By designing games in a variety of genre (puzzle, narrative, simulation, quiz games, etc.) that support the desired learning outcomes, players can find an approach that is well-suited to their learning styles. By meeting employees "where they are" we can provide training and support that will benefit both the individual employee and the organization, thus fostering a culture of continuous learning across the agency.

E-TAG: Employee Training and Growth through Electronic Games

Electronic games have been used in the workplace to help employees gain new skills since the beginning of the digital era. For example, when Microsoft introduced its new Windows 3.0 ™ interface for personal computers in 1990, two games were built into the software: Solitaire and Minesweeper. Solitaire was included to promote the use of the drag-and-drop feature of the mouse, and Minesweeper provided opportunities to practice left- and right-clicking.

Use of the computer mouse and left-and-right clicking were new skills that have since become essential for office workers, as personal computers became first prevalent and then ubiquitous in the workplace. We are proposing an app, E-Tag, that will achieve the same goal: using games to train employees in the workplace.

As most of us can attest, games are fun and engaging because they challenge us to think strategically, plan ahead, and solve problems. Games can be single or multi-player, competitive or cooperative, and promote higher order thinking skills. In fact, studies have shown that video games can improve focus, memory, and vision (Bediou, Benoit, et al., 2018; Primack, et. al, 2012). The National Science Foundation's Career Compass Challenge calls for creative use of technology, in the form of an app that can be used across devices, to provide employees with the opportunity to expand their skills and advance their careers. We believe that the key to adoption of this app lies in making it useful, fun, and engaging; the key to its effectiveness lies in the app's adherence to adult learning theories.

Andragogy (Knowles, 1980) is the art and science of helping adults learn, based on several assumptions about adult learner characteristics. First, adult learners are ready to learn when they assume new social or life roles and are motivated by internal factors. As they mature, these learners move from dependency to increasing self-directedness, drawing upon accumulated reservoirs of life experiences to aid learning. Most importantly, the adult learner is problem-centered and wants to apply new learning immediately.

Knowles recommends that educators who are working with adults set a cooperative climate for learning, assess the learners' specific needs and interests, develop learning objectives based on those needs, interests, and skill levels, design sequential activities to achieve the objectives, and work collaboratively with the learner to select methods, materials, and resources for instruction. E-Tag was conceived with these principles in mind.

While technical skills are important in the workplace, some of the most valuable skills are the hardest to teach in a traditional classroom environment. A 2018 survey of 500 employers by the American Association of Colleges and Universities asked hiring managers and executives about the importance of various intellectual and practical skills for recent college graduates (https://www.aacu.org/leap/public-opinion-research). Oral and written communication were deemed of primary importance, as was working with diverse teams, critical thinking and reasoning, and complex problem solving (Figure 1).

Computer games have been embraced by individuals across generations. According to a study by the Entertainment Software Association, there are currently 2.2 billion gamers worldwide. The average gamer is 35 years old and has been playing for 13 years. Furthermore, 41% of gamers are female, 44% of gamers are 36 or older, and over one-quarter are over 50 (Medicare Solutions, 2018).

We envision an app that:

- Provides tools (games) that evaluate the user's current skill set and comfort level on a variety of attributes, including: problem solving, quantitative reasoning, writing, reading, and critical thinking.
- Provides features that allow users to understand their own interests and abilities and maps those abilities to specific jobs.
- Allows for the exploration of various other positions within or outside of the current organization, by supporting a virtual network of mentors as resources for career management and planning.
- Supports the development of specific technical skills in the context of solving problems that are directly relevant to the current or future position.
- Provides opportunities for team building within a unit or organization.
- Supports a feedback mechanism to the app development team, so additional games and levels are added as the need for new skills are identified.

Employer Priorities on Select College Learning Outcomes

	Very important for recent grads	
Intellectual and Practical Skills	**Executives**	**Hiring Managers**
• Oral communication	**80%**	**90%**
• Teamwork skills with diverse groups	**77%**	**87%**
• Written communication	**76%**	**78%**
• Critical thinking and analytic reasoning	**78%**	**84%**
• Complex problem solving	**67%**	**75%**
• Information literacy	**73%**	**79%**
• Innovation and creativity	**61%**	**66%**
• Technological skills	**60%**	**73%**
• Quantitative reasoning	**54%**	**55%**
Personal and Social Responsibility		
• Ethical judgment and decision making	**77%**	**87%**
• Work independently—set priorities, mangage time/deadlines	**77%**	**85%**
• Self-motivated—ability to take initiative and be proactive	**76%**	**85%**
Integrative and Applied Learning		
• Applied knowledge in real-world settings	**76%**	**87%**

Figure 1: Employers impression of importance of skills across majors (from: https://www.aacu.org/sites/default/files/files/LEAP/1_KeyFindings.pdf)

To better understand the motivation for this app, and how it can be used to the benefit of both employees and managers, consider three case studies:

Case 1: John Williams was hired into the National Science Foundation as an Office Automation Clerk last year. He has good general office skills and works well with others. Both John and his manager recognize that he has the ability to improve his skills, and move into more advanced roles, which will both increase his earning potential and be more intellectually stimulating for John. Either Program Assistant or Administrative Support Assistant appear to be possible next steps, but which should they target? How can John prepare himself for either of these roles? Are there other roles that John and his manager are unaware of?

Case 2: Rebecca Levy has worked for the NSF for over 10 years and has been comfortable in her role as an IT Specialist. She learns new technologies easily and is productive when working alone. A recent performance evaluation indicated that Rebecca needs to improve her ability to work with diverse teams. She can be impatient when working with others and would prefer to do things herself rather than delegate or share knowledge. Her manager has made it clear that Rebecca will not be considered for promotion until she improves in this area. Can E-Tag help?

Case 3: After a robust and inclusive evaluation and recommendation process, the NSF has decided to replace the current accounting systems with a product from a new vendor. This software is used by virtually every employee at the NSF and manages everything from budget planning to expense reimbursement. The system has basic and advanced features, and, although the vendor will include training sessions as part of the roll-out, the need for ongoing training will be significant. Furthermore, the use of the new system will require substantial changes in current procedures, and employees also need to be made aware of the new policies and processes.

While there is little agreement on the classification of games into genres, there is some common terminology. Puzzle games (Tetris™, Hidden Picture Games, Candy Crush Saga™) challenge users to problem solve and recognize patterns in order to score points and move through levels. They develop skills such as logical reasoning and attention to detail. Simulation games (The Sims™, Flight Simulator™) mimic real world situations and interactions, often allowing multiple players to interact with each other. Strategy games (Risk™, Minecraft™, Angry Birds™) encourage users to creatively try multiple options and often require multiple steps to achieve a goal. Quiz games (HQ Trivia™, Trivia Crack™) allow users to score points and challenge other users to friendly matches.

Many game apps now have an associated social interface (some more sophisticated than others), which allow users to interact and trade tips for conquering levels or just congratulate each other when goals are achieved. Some games expand these social features to make a traditional single player game into a team experience, with each team member receiving in-game rewards for reaching a shared goal.

The E-Tag app envisioned here is comprised of a virtual world as well as a collection of games. When users first open the app, they are encouraged to complete a series of fun quiz games that assess their general knowledge and skills in areas such as math, writing, reading comprehension, science, and general knowledge. Domain specific knowledge can be added when appropriate. As with most games, completing levels in this series rewards the user with tokens or other forms of "currency" which can be used to unlock additional features of the app. We are not artists, but a simple rendition of the home screen and the Assess screen is provided in Figure 2 (using a Doors metaphor).

In Figure 2, we show that two doors are unlocked when the user opens the app, and the player receives a basic bank of star and coin tokens that can used throughout the game. These tokens can unlock additional doors and purchase special features in-game. They can be earned by completing game activities in unlocked regions of the app. The door metaphor (which is arbitrary but works for instructional purposes) is carried through on each level, making the interface simple and intuitive. Each door may lead to a nested series of more doors or may open up a game directly.

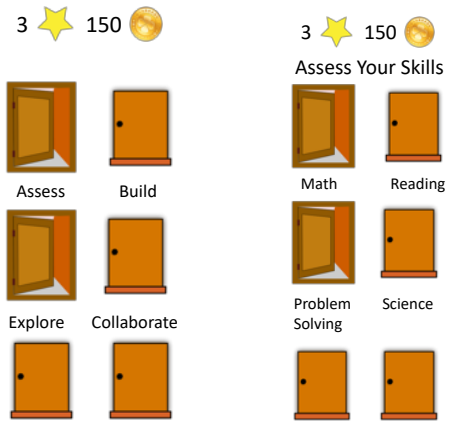

Figure 2: Simple interface

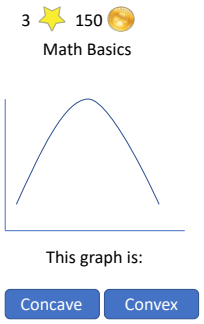

Figure 3: Quiz game question

Figure 3 depicts a question that might appear in the mathematics section of the assess your skills quiz game. Correctly answering the question (*concave*) will earn coins. Successfully completing the entire section will earn a star. The Quiz games in these sections will be developed with adaptive technologies, similar to those now used on standardized tests such as the Graduate Record Exam (GRE). These technologies ask questions in such a way as to determine the level of the individual without the need for testing every area or requiring a user to answer repetitive and similar questions. Correct answers will result in harder questions, incorrect answers will scale the level back a bit. Once the user has converged on a specific level, the quiz will end. Use of adaptive technology will keep the player engaged with the game, as s/he will not be frustrated by questions that they cannot answer correctly and will not be bored by questions that are too easy. It will also keep the quiz time short enough to be answered in a few minutes so users can make progress in the game whenever they have an opportunity.

The best way to understand a particular job is to talk with someone currently in that role. In Figure 2, the "Explore" door was also unlocked at the beginning of the game. This option allows the user into a Sims™ type of environment where s/he develops an avatar that interacts with other users (real and computer generated) to explore career options (Figure 4). The user can interact with any avatar it finds in the game by asking questions or doing virtual job shadowing. Players can also set personality attributes on their avatars, and these attributes can serve as conversation openers with other avatars and/or provide the game engine with data that it can use to direct the player to certain regions and job functions. Someone who loves to work on the

computer might be directed to talk to a player who spends a lot of time working with Excel spreadsheets, while someone who enjoys writing and editing may be directed to a web content developer. In real-life it might take weeks or months to form the same connections that can be formed in a game within minutes, and the anonymity of interactions between avatars can reduce awkwardness and enhance the flow of communication.

In this "Virtual Workplace" game every player contributes to and learns from the others, providing positive reinforcement for skills already mastered and used in players' current role, while also showcasing opportunities across the organization. Robust content management will be required to fully develop this game, so that a player who finds an intriguing option can identify the skills needed to fill the gaps in his/her current knowledge in order to qualify for a particular position. In this section, users can earn coins and stars by spending time in game, achieving certain goals (e.g. talk to three new people), or doing little in-game activities that are hidden throughout the virtual world (spin a wheel, find a special box, etc.). They can also "like" positions that appeal to them or skills that they might be interested in acquiring.

Figure 4: A conversation in the Explore option (credit to: https://simsvip.com/2018/03/06/sims-4-first-pet-stuff-new-render-screenshot/)

As noted above, andragogy is the art and science of helping adults learn. In particular, many adults are drawn to *self-directed learning* (SDL), which is a process whereby individuals take the initiative, without the help of others in planning, carrying out, and evaluating their own learning experiences. Self-directed learners have been shown to experience greater confidence in their work and to adapt better to new learning environments (Knowles, 1980; Levett-Jones, 2005). *Transformational learning* (Mezirow, 1991) is often described as learning that changes the way individuals think about themselves and their world and involves a shift of consciousness. Valdez (2002) recommends this approach when exploring sensitive and challenging issues in multiculturalism and diversity with adult learners. E-Tag supports self-directed, transformational learning for adults in a fun, intuitive way.

A learning platform like E-Tag is well suited to adult learners who typically have job and family responsibilities, and therefore have limited time. E-Tag can also reduce the stigma that is sometimes associated with learning. Failure in a game is a usual and natural circumstance and is perceived by players as an obstacle to overcome. In most cases, failure to achieve a goal in a game happens in a private setting. By contrast, even with a skilled and compassionate teacher, an

incorrect answer in a classroom is perceived as a "public" failure, particularly for adult learners who may have been out of the classroom for a long period of time. Thus, if done well, a game environment like E-Tag can overcome both physical (time, location) barriers to obtaining new skills and improving existing ones, as well as socio-emotional barriers (facing a teacher or fellow students).

Once the E-Tag player has completed some of the assessment games, and, perhaps, explored the Virtual Workplace, she is ready to focus on building or improving skills and the build door will become unlocked. This area will contain a collection of skill building games, aggregated by the game engine. The recommendations might be based on the assessment quizzes or may have resulted from the interactions in the Virtual Workplace (perhaps the user "liked" a particular type of position – thus indicating interest in learning more of the skills required for that role). Each player will have different games offered behind the "Build" door, tailored to his/her preferences and needs. Figure 5 demonstrates this concept. Here, two players are presented with their individual skill building area.

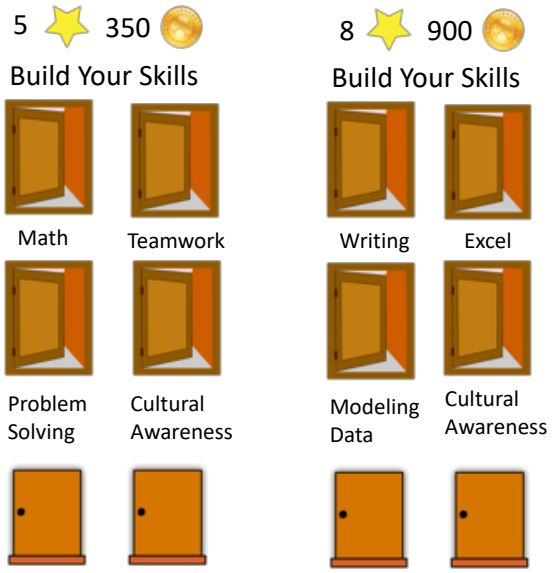

Figure 5: Customized Skill Builder for two different users

Development of this section will require a deeper dive into the skills and attributes that are important to the employer, and each game will be customized with an appropriate genre to achieve the skill goal. For example, the Teamwork goal may require the player to participate on team to achieve a particular goal (for example, playing levels to gather materials to build a castle). At a basic level, the user would first be a lower-level team member, forced to follow directions from more senior players. Failure to follow instructions or participate in a way that helps the entire team (even if this impedes the ability of the individual player to score well), will be severely penalized. As the player learns the importance of cooperation and team decision-making, she/he will be given more latitude and decision-making power within the game itself. The entire team will be rewarded, and the player may notice that his/her overall score ranking improves, even in situations where he/she has sacrificed for the team. Eventually, players who do

well will earn the right to lead their own teams, giving them opportunities for leadership development as well as teamwork development.

The organization will also have the ability to "assign" skill building games to all or some employees. In Figure 5, the "Cultural Awareness" skill was added for every employee, as the organization recognizes the importance of fostering a diverse and inclusive work environment. This game might include a series of "Narrative" style games that lead players through different scenarios, where they play levels (typically various types of puzzle games) to earn the right to unlock the next section of the story. Interleaved in this section is an opportunity to answer questions that force the player to reflect on his/her personal values and how they play out in the workplace. These reflections are often used in a classroom setting to encourage students to consider the moral and ethical consequences of their decisions and behaviors. By interleaving this into game play by, for example, allowing players to direct some of the actions of the characters in the narrative, players can learn to think ethically about their attitudes and behaviors in the work environment.

The stars and coins (or other tokens) that are earned here and elsewhere in E-Tag can be used to unlock special levels or obtain "cheats" or "hints" for the skill building games. Additional doors on the home page can be unlocked (with enough tokens) and allow the player to customize his/her avatar or game environment or earn opportunities to participate in special events that may occur for a limited period of time.

Of course, the tracking the usage of different aspects of the E-Tag gaming environment will be important to the organization, and certain app activity will be reported to a central server. Attributes such as time in app, levels completed, specific skill tasks completed, last usage date, etc. will be useful and important. However, it will also be important that the employer not over manage game usage. Incentives can be used to encourage employees or units to participate in the E-Tag environment. Similar to walking or wellness competitions that are common in today's workplace, units can compete in friendly ways for the most team members involved in the E-Tag environment or the most coins or stars achieved in a given time period. Employees can also form their own teams and groups in-game in order to set up their own competitions with other in-game groups and this can be rewarded in-game with additional tokens or special game features becoming available only when an in-game group achieves a particular goal (either one they set themselves, or one that is set by the gaming environment).

Revisiting the case studies mentioned above, let's see how E-Tag might support each situation.

> **Case 1**: John uses the Assess features of E-Tag to determine his strengths and areas of improvement. He explores the Virtual Workplace and speaks to others who are in the roles he has in mind (Program Assistant and Administrative Support Assistant). These tools highlight John's quantitative and analytical reasoning skills and recognize that he needs additional support in written and verbal communication. John uses the game to build his vocabulary, and focus on concise and correct writing, while continuing to participate in the Virtual Workplace, both learning from others and sharing his experiences. One evening, as his avatar wanders the virtual world, he speaks with another employee who is the Business Operations area. John is nearing completion of his

associate's degree at a nearby community college and is considering what direction to take to further his education. This serendipitous interaction in the Virtual Workplace provides a new insight for John. He continues to work on his analytical and MS Excel skills in order to apply for a position as a Program Assistant, but he also begins to seriously look into completing a bachelor's degree in accounting and earning his CPA license. Not only does John have a sense of his next step within the NSF, he also has identified a long-term goal that suits his interests and personality.

Case 2: Rebecca's supervisor strongly recommended that she explore the E-tag environment, where she reluctantly participated in the skill building exercises for teamwork and cultural awareness (games are never fully "complete," there is always a new level or challenge). One morning, upon launching the game, she did not immediately enter into the "Build" area as usual but instead chose the "Explore" option. Rebecca's avatar began to interact with others, and she found the environment fun and interesting. However, there was work to be done and she redirected her gameplay back to the assigned "Build" games. Over the next few weeks she developed a habit of spending a bit of time in the "Virtual Workplace" before returning to the skill builder. Her avatar struck up a few friendships with others who had chosen leadership roles, as well as those who had taken a more technical career path. During these interactions, she recognized that, although a position of supervisor was the standard route to advancement at NSF, the idea of spending her days in meetings and producing reports did not at appeal to her. Ultimately, Rebecca discovered a technical career path that was more aligned with her personality and interests. She also learned, through the skill builder and the "Virtual Workplace" to understand the importance of diverse perspectives, and to appreciate those who were willing and able to serve in formal leadership roles.

Case 3: The software vendor is excited to learn that they have won the contract with the prestigious National Science Foundation; however, the NSF team has inserted a strange clause into the contract. In addition to the standard "train the trainer" courses that are provided to each new client, the contract stipulates that the vendor must participate in a design exercise for the development of a simulation game designed to teach every employee how to interact with their software product. Furthermore, these design sessions will require considering new business processes and determination of how each employee may (or may not) interact with their software product. The simulation game that is jointly developed by the vender, the E-Tag development team and the NSF, becomes a virtual sandbox, where employees can explore features of the software and practice using them, without accidentally submitted incorrect financial information. After the simulation game is developed and launched, the NSF is surprised to learn that some players have invested wholeheartedly in these gaming modules, essentially making themselves into gurus on the new software. These individuals are highly sought after, informal, consultants for other employees within the NSF and a culture of subject matter experts grows organically within the organization.

Our proposed solution to workforce development in the 21st century, described herein, draws upon learning theories employed in a variety of disciplines which all share common challenges related to training adult learners in workplace settings. Simulation, for example, has been shown

to be extremely useful for training surgeons or pilots, and is now common practice when the stakes are extraordinarily high. E-Tag extends this model downward, for use in day-to-day training and preparation for skills and attitudes that will be critical for success in the 21st century. Specifically:

E-Tag provides opportunities for reinforcement of fundamental skills as well as job specific training. Through assessment and reinforcement, employees can be encouraged to improve their oral and written communication, quantitative and analytical reasoning, innovation, creativity and dealing with ambiguity. These foundational skills are critical for improving the workforce and moving an organization forward in an era of uncertainty and disruptive technological advances.

E-Tag provides a unique answer to the question of career exploration. Rather than provide lists of skills and/or degrees which may map to a particular position (and which would have to be continually updated to remain current), E-Tag provides an "Virtual Workplace" environment whereby players (i.e. employees) learn from each other. Information on educational opportunities is prolific online, and no single app could be a clearinghouse for every program that might be useful. Furthermore, curating such a list of opportunities would not only be difficult, it would also create the appearance of a governmental agency favoring one institution or program over another. The Virtual Workplace solves both problems. Employees can share their experiences, both on the job and in more traditional academic settings, with each other within the game environment. This will not only allow employees to easily and quickly obtain information about various external and internal programs that they would find beneficial, they can also ask the types of questions that may be most useful in removing barriers to furthering their education, including questions such as: How did you manage that program while raising a family? Was it intimidating to go back to school? Was it really worth the time and expense?

E-Tag incorporates elements from current learning theory models for toward adult learners in a workplace environment. Models such as cognitive learning theory which posits that giving control to the learner and allowing them to use previous experience enhances their learning experiences (Piaget, 1972; Rutherford-Hemming, 2012). Similarly, social learning theory (Bandura, 2001) notes that we begin to self-regulate through observing others and adopting socially acceptable behaviors. Finally, experiential learning (Rutherford-Hemming, 2012) has been proven to most improve skills over time, and lower barriers to learning.

E-Tag is flexible and expandable as needs change over time. The E-Tag environment is highly modularized and adaptable. Each game requires both content development and careful attention to maximizing learning through game play. The designer must consider the choice of game genre, the system of penalties and rewards within the game, the level of interaction with others, how the game will progress as each skill is mastered, etc. The designer must also work closely with the organization on content development, to ensure that the right skills are being learned, assessed and reinforced throughout the game. However, it will be possible to develop multiple modules in parallel and roll out modules

and game levels as they are developed. The benefits of this approach are two-fold. First, an early version of E-Tag can be made available fairly quickly. Second, the additional of modules and levels over time will add interest to the game and draw players back to it.

E-Tag is designed to encourage adoption and reuse. One of the biggest concerns for any new software platform is how to engage users and keep them interested. E-Tag addresses this concern by providing opportunities for management and employees to engage with the platform in fun and interesting ways (both within and external to the game). The organization can encourage use by fostering friendly competitions between units, maybe offering a pizza lunch for the group with the highest percentage of players within a given month, etc. The platform itself is engaging and can appeal to users who want to assess themselves, build skills, or explore career options. The variety of game genres ensures that the game will not be boring, and the ability to earn tokens and stars while learning provides for positive reinforcement. The social learning aspects of the Virtual Workplace will be especially appealing for those who learn best by speaking with others, and the opportunities for both team and individual gameplay address different learning styles.

The NSF Career Compass Challenge imagines a solution that is accessible to all employees with a low barrier to entry and promotes continuous learning. Quoting from the challenge description:

> *The future world of work may not be recognizable yet, however a ready workforce will remain critical for both economic prosperity and mission accomplishment. Employers must start now to instill a culture of continuous learning in its most critical resource, the workforce. To do this, we must think creatively about broadening the pool of available candidates by lowering the barriers for access to opportunities. This journey begins with a mechanism that enables individuals to self-select and prepare for chosen work that complements their skills and interests. The future of work is one of continuous change, which depends on a culture of continuous learning.*

E-Tag is a cross-platform software gaming engine that provides employees with a fun, engaging way to access information, improve their skills and learn about future opportunities inside and outside of the agency. E-Tag will be developed initially to support employees within the NSF, and can be extended over time to other agencies, and even the private sector. The foundational modules are important to all employers, and organization specific modules can be added when appropriate. If successful, E-Tag can serve as open-source training platform, with opportunities for broad scale implementation in a variety of industries.

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